Castilleja

Publication of the Wyoming Native Plant Society

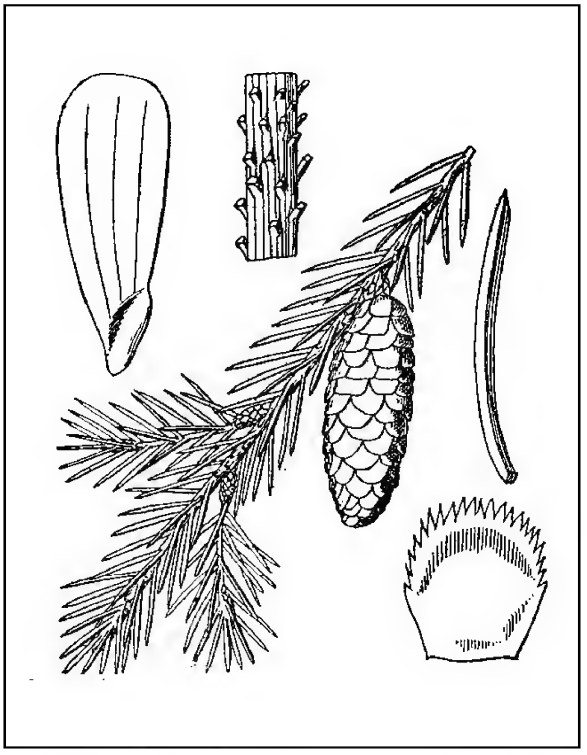
October 2011, Volume 30, No. 3

Unexpected Distribution of Spruce Species and their Hybrids in Wyoming Mountain Ranges

By Monia S. H. Haselhorst & C. Alex Buerkle

In 2010, the U.S. Capitol Christmas Tree was a 67-foot tall spruce from the Bridger-Teton National Forest in Wyoming. According to our recent genetic study of the prevalence of hybrids between white spruce (*Picea glauca*) and Engelmann spruce (*P. engelmannii*) in the region, this tree could very well have been a hybrid, rather than the Engelmann spruce it was reported to be.

Spruce species are known to hybridize in North American forests, and in many locations they can be difficult to identify reliably based on morphological characters. Although the geographical ranges of North American spruce in general are well known, many questions remain about the zones where species come into geographic contact; if they hybridize, how widespread and prevalent are hybrids and how can hybrids and parental species be reliably and accurately identified? Hybridization is known to occur between several spruce species in North America: between black spruce (*P. mariana*) and red spruce (*P. rubens*) in northeastern North America, between Sitka spruce (*P. sitchensis*) and white spruce (*P. glauca*) in British Columbia, and in interior British Columbia and Alberta hybridization between white spruce and Engelmann spruce (*P. engelmannii*) is so extensive that spruce from this region are often identified as "interior spruce" (Rajora & Dancik 2000). (Continued, p. 10)



Above: White spruce (*Picea glauca*). From: Britton, N.L., and A. Brown. 1913. *An illustrated flora of the northern United States, Canada and the British Possessions. 3 vols.* Charles Scribner's Sons, New York. Vol. 1: 61. Courtesy of Kentucky Native Plant Society. Scanned by Omnitek Inc.

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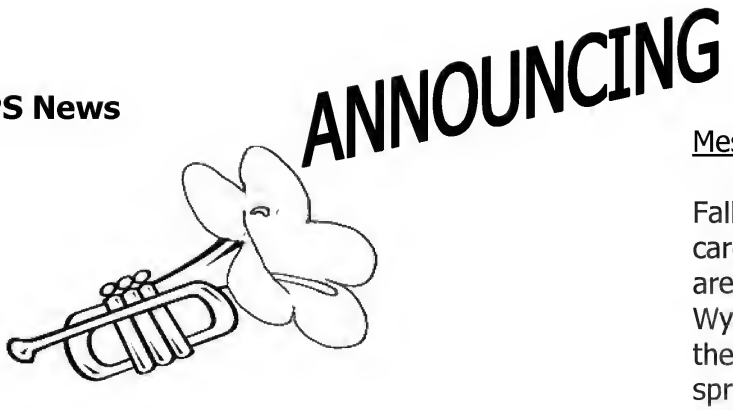
WNPS News



We are pleased to announce that Wyoming Native Plant Society will hold joint annual meetings with the American Penstemon Society next year, June 22-25, in Laramie. Fieldtrip organizer for the event is Dorothy Tuthill (dtuthill@uwyo.edu), for American Penstemon Society and Wyoming Native Plant Society. *This may be unprecedented in advance-planning*... look for further information in future newsletters!

New members: Please welcome the following new member to WNPS: Ruth Beckwith, Sheridan; Beverly Boynton and Ray White, Kelly; Meghann Durbrow, Pinedale; Larry Haimowitz, Laramie; Julie Kraft, Pinedale; Mary Lohuis, Jackson; Kathy McCurdy, Moose; Patricia Mellon, Saratoga; Harriet Dodd Port, Boulder; Barbara Rogers, Oakland, CA; Emma Stewart and Nick Freeland, Laramie; Nancy Thomas, Star Valley Ranch; Zach Wallace, Lander.

Treasurer's Report: Balance as of 12 September: Scholarship = $2,967.50; General $5,159.60; Total = $8,127.10.

Contributors to this Issue: Ann Boelter, C. Alex Buerkle, Robert Dorn, Walter Fertig, Monia Haselhorst, Bonnie Heidel, Chris Madson, Amy Taylor, Dorothy Tuthill, Brenna Wanous.

2012 Markow Scholarship announcement: Online soon and in the next issue. *See the front page article from a past Scholarship winner.*

*****

The next newsletter deadline is November 28. Articles, announcements, and suggestions are welcome any time! *Each newsletter issue marks a challenge – how to reflect the volume of news and even the lack of news for something as vital as Wyoming's plants and vegetation.*

Message from the President

Fall Greetings! Goodbye chlorophyll. Hello carotenids and anthocyanins. These plant pigments are gloriously expressing themselves throughout Wyoming. I hope you were able to attend one of the many plant hikes offered statewide this past spring/summer. Thanks to all the 2011 fieldtrip collaborators (Buffalo Bill Historical Center, Bighorn Native Plant Society, Teton Chapter (WNPS), Great Plains and Idaho Native Plant Societies, Washakie Museum, Paleobotanists at Big Cedar Ridge, Bureau of Land Management - Worland). We are considering producing another fieldtrip flyer next year and encourage your feedback. My summer highlight was celebrating 30 years of WNPS in the Bighorns – a wonderful gathering of plant enthusiasts appreciating a unique flora. With a botanically full summer behind me, I am savoring the slower pace, foods, cardigans, and colors of fall. Hope you are too!

~Amy Taylor

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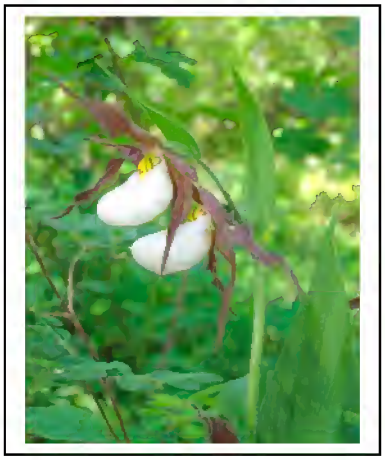
2011 Annual Meeting Highlights

Above: President Amy Taylor, with WNPS 30th Anniversary Cake, leads the chorus
Upper left: Dandelion jewelry demonstration
Left: Trey Davis, at Tensleep Preserve
Below: Mountain meadow mob
Lower right: Jeannine Strenk in field footwear
Right: Mountain lady's-slipper
Upper right: Adrienne Pilmanis demonstrates a new use of the state flora (Dorn 2001) to speed up plant hikes – don't look down until you arrive at your destination!

*THANK YOU TO **ALL** WHO CAME*



Left: Scarcely two months after planting, the Berry Prairie was going gangbusters as the first green roof at the University of Wyoming. Photo by Dorothy Tuthill, September 2011.

Left: Wyoming big sagebrush (*Artemisia tridentata* var. *wyomingensis*) leaves are collected for a stable isotope lab from the Berry Prairie. Photo by Brenna Wanous.

PUTTING PLANTS TO WORK:

BERRY PRAIRIE GOES GANGBUSTERS

By Brenna Wanous and Dorothy Tuthill,
Berry Center

The green roof atop a portion of the Berry Biodiversity Conservation Center in Laramie is a medley of Wyoming's prairie and steppe vegetation. Dubbed the "Berry Prairie," the Berry Center's green roof contains 62 species of native plants, most of which are widespread in Wyoming, including five species of *Artemisia*, five species of *Penstemon*, three species of cacti , eight species of grasses, and many others.

One of the unique design aspects of the green roof is the range of habitats combined into this 3,600 square foot space. There are three watering zones in the Berry Prairie: arid, semi-arid and mesic, and each zone contains species characteristic of those natural environments. This leads to a green roof that contains very different species all in one area; cacti and yucca are found across the pathway from Oregon grape and Colorado blue columbine. This unusual set up creates a wonderful environment for research and experimentation in botanical processes as well as green roof design.

Another unusual characteristic of the green roof is the soilless medium in which the plants grow. The weight of natural soil, particularly if it is saturated and is underneath 18 inches of snow, greatly exceeds the weight-bearing capacity of a roof, even one that is built specifically to hold a green roof. The growing medium is a mixture of scoria and expanded shale, with what appears to be chipped wood as the organic component. (The exact mixture is proprietary.) Initial soil testing conducted by Penn State University shows the pH at 8.1, soluble salts at 1.67 g/L and 8.9% organic matter content. Phosphorus, potassium, magnesium and nitrate/ammonium were at moderate levels.

While this information doesn't paint a clear picture of how the green roof medium compares to any soil types in Wyoming that would be characteristic of a prairie, it gives a baseline for studying how the "soil" changes over the life of the green roof. It allows us to ask questions surrounding how plant decomposition influences soil nutrient content, how long it may take for mycorrhizal connections to form, whether additional nutrient inputs will be required or if the "soil" texture is prohibitive for doing so, and more.

So far, the Berry Prairie experiment has been successful—a late start in planting was more than compensated by summer rains. Many plants bloomed this summer and fall, some have set seeds, and only a few have succumbed. Of course, the big test comes next spring, when eager botanists and gardeners take stock of the—we hope—vigorous and happy plants in the aftermath of Wyoming winter.

To track the goings-on of the green roof, the Berry Center staff maintain a blog found at berryprairie.blogspot.com. Topics include flowers and grasses in bloom, education programs occurring on the roof, which species are doing well and which are struggling, and more. Topic suggestions are always welcome (email berryctr@uwyo.edu with suggestions)! A complete list of plants in the Berry Prairie is available at www.uwyo.edu/berrycenter/greenroof/index.html.

The Berry Prairie is always open to the public. It is located near the south doors of the Berry Center on the corner of 10th and Lewis on the UW campus, just west of the Geology building. Visit www.uwyo.edu/berrycenter to learn more about the Center's mission and projects.

Growing Native Plants

Part 1. Background

By Robert Dorn

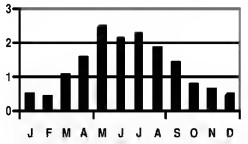
There are many reasons for growing plants native to Wyoming. Perhaps the most important reasons are that natives are best adapted to our growing conditions, they need less water than most exotics, they are more resistant to our pests and diseases, and their use will help reduce the growing of exotics which often results in their escaping and thereby deteriorating our native landscapes. Every exotic plant that escapes from cultivation displaces a native plant. When you grow exotic plants, do not allow them to escape and naturalize.

The key to successfully grow native plants is to duplicate their natural habitats as closely as possible. The most important factors to consider are soils, moisture availability, topography, and sun exposure. Other less important factors include wind exposure, elevation and associated temperature differences, and winter snow cover.

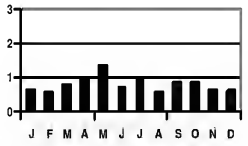
The importance of soils is best illustrated by observing the plants that grow on loamy, sandy, clayey, rocky, and highly alkaline soils. The plants will be different on each of these sites. In addition to the physical and chemical characteristics of these different soils, the soil depth should be considered. Shallow soils support different plants than deep soils. Some plants tolerate several different soil types whereas others may tolerate only one type.

Moisture availability includes amount of precipitation, timing of precipitation, soil moisture holding capacity, runoff, subirrigation, evaporation rate, and the amount of moisture a particular plant requires and at what times. In Wyoming the most precipitation falls in the mountains, the next most on the plains of the eastern half of the state, and the least in the basins of the western half of the state. Precipitation is somewhat uniform throughout the year in the mountains and western basins, but the amounts in these two areas are very different and there may be a little more in spring. On the eastern plains most precipitation comes during the growing season from April to August. Plants taken from one of the three areas and planted in another area may need to have their moisture needs addressed with supplemental irrigation or by planting them on a very dry site if moved from a dry area to a much wetter area.

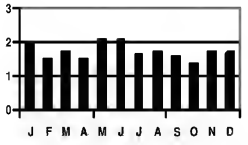
Average Monthly Precipitation in Inches



Cheyenne



Rock Springs



Lake Yellowstone

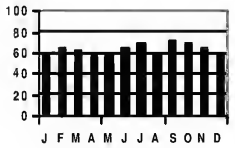
Clay soils resist water infiltration, but once infiltrated, the water is held very tightly. Sandy soils allow water to pass through easily without retaining much, so they dry out faster than clay soils. There will be more runoff from clay soils, especially if they are sloping rather than flat. Subirrigation is usually due to being close to a stream or pond or close to a water table in low lying areas. Evaporation is mostly controlled by temperature and humidity so will be highest in dryer areas and areas with warmer temperatures.

Topography is interrelated with moisture availability. Slopes will have more runoff than flat areas, and south facing slopes will be dryer than north facing slopes. The steeper the slope, the greater the effect. In addition, some valley areas are cold air sinks and will be colder at night than surrounding hills or mountains.

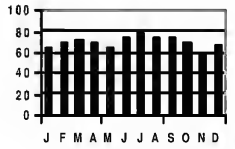
Sun exposure is also interrelated with moisture availability. Direct sunlight can dry out the soil rapidly. Many of our native plants require direct sunlight, but a few will only survive in deep shade. South facing slopes will be warmest and

driest; north facing slopes will be coolest and wettest.

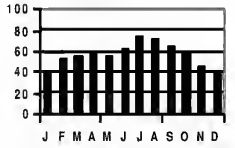
Average Percent Possible Sunshine



Cheyenne



Lander



Lake Yellowstone

Wind is primarily a problem for plants that do not normally grow in wind prone areas. Some wind protection may be needed for these. Wind protection for all plants will often benefit them.

Temperature generally decreases with an increase in elevation. Temperature is most important in contributing to the drying of soils. The warmer the temperature, the more the drying. Absolute temperatures are usually not important for our native plants except when moving the plants from one extreme to the other, hot to cold or cold to hot.

Winter snowcover often moderates the overwintering environment for plants in our snowier areas. If these plants are moved to an area with little winter snow, they may need mulch protection in winter.

One final factor to consider is that growing many different species and not much of any one species will reduce pest and disease problems. Diversity is better than a monoculture.

Additions to the Flora of Wyoming

A New Sandwort for Wyoming

By Walter Fertig

(*Editor's Note: The following is reprinted from Sego Lily 34(5) September 2011.*)

In recent years taxonomists have resurrected the genus *Eremogone* for species with narrowly linear leaves and 6-toothed capsules that what were formerly included in the genus *Arenaria* (sandworts) of the Pink family (Carophyllaceae). While working on their treatment of *Eremogone* for the upcoming final volume of the *Intermountain Flora*, Noel and Pat Holmgren of the New York Botanical Garden examined hundreds of specimens in the *Eremogone kingii/fendleri* complex and became convinced that collections traditionally identified as *Arenaria kingii* var. *uintahensis* were sufficiently distinct to warrant recognition as a full species. Unfortunately, the name *uintahensis* turned out to be unusuable, because the typic collection of the variety was actually a specimen of *A. kingii* var. *glabrescens*.

Enter "Arnow's sandwort" or *Eremogone loisiae*, named to commemorate longtime Garrett Herbarium curator, Lois Arnow. ... *Ermogone loisae* can be distinguished from *E. fendleri* by its more ovate sepals and from *E. kingii* var. *glabrescens* by its larger sepals (4-7 mm long vs. 2-2.5 mm). Arnow's sandwort is most similar to *E. eastwoodiae*, but has longer and more flexuous basal leaves (2.5-5 cm long), and larger styles and seeds (Holmgren and Holmgren 2011). This new species is represented by one Wyoming specimen from western Uinta County, otherwise restricted to the Wasatch Range and vicinity of southern Idaho to central Utah.

Literature Cited

Holgren, N.H. and P.K. Holmgren. 2011. A new species of Eremogone (Caryophyllaceae) from northern Utah and southeastern Idaho, USA. Brittonia 63(1): 1-6.

Additions to the Flora of Wyoming

Three New Bryophytes for Wyoming

(*Editor's note: The following is extracted from Kosovich 2011, and Andrus and Kosovich 2011.*)

Bryophyte floristic research by Yelena Kosovich-Anderson has documented three more moss species that are additions to the Wyoming flora and highly disjunct in the Rocky Mountain states[1]. They include a species of *Sphagnum* from the Medicine Bow Mountains and two Dicranaceae species from the Beartooth Plateau. All three species discoveries are from fens.

Sphagnum jensenii H. Lindb. was collected by Kosovich-Anderson in a Medicine Bow Mountains fen with floating peat mat habitat (Andrus and Kosovich-Anderson 2011). The closely related species *Sphagnum annulatum* Warnst. had been reported for Wyoming in the Medicine Bow Mountains (Eckel 2007) so a review of known specimens was also undertaken, one of which was annotated to *S. jensenii*. *Sphagnum jensenii* occurs in the northern boreal forest region in North America and Eurasia at low to middle elevations. By contrast, the Medicine Bow collection site of Kosovich-Anderson is a high elevation site at 9,600 ft (2925 m). The Medicine Bow Mountains collections represent the only ones known in the lower 48 states, a range extension from the nearest collection station close to Edmonton, Alberta in Canada. The authors characterized *S. jensenii* as a disjunct *Sphagnum* species in the Sect. *Cuspidata* that is typically much more desiccation tolerant than other *Sphagnum* sections. Survival as relictual populations may be favored by the ability to recover and regenerate from occasionally drying out.

The two new Dicranaceae species from the Beartooth Plateau are both arctic-alpine species.

Campylopus schimperi Milde was collected by Kosovich-Anderson in a subalpine Beartooth Mountains plateau fen, where it formed pure mats on saturated soil at the base of low patterned hummocks around swales (Kosovich-Anderson 2011). It is a rarely-collected arctic-alpine species of North America and Eurasia, otherwise only known from Colorado among the lower 48 states. In Colorado, it is described as "...a common but easily overlooked species of the subalpine and alpine snow melt areas, occurring on saturated soil around lakes and solifluction terraces. It is an inconspicuous and nondescript sod-former without any obvious field characters..." Weber and Wittmann (2007, p. 67).

Dicranum elongatum Schleich. *ex* Schwägr. was collected by Kosovich-Anderson in an alpine Beartooth Mountains plateau fen, where it formed compact tufts in hummocks dominated by *Aulacomnium palustre* and *Sphagnum* Sect. *Acutifolia* species (Kosovich-Anderson 2011). It is widespread in arctic or alpine tundra all across the Northern Hemisphere, previously known from New England states and from the Rocky Mountains of Colorado and northwestern Montana.

[1] See also: *Castilleja* 30(1) re. Kosovich-Anderson and Ignatov 2010, and *Castilleja* 28(1) re. Kosovich-Anderson and Spence 2008.

Literature Cited

Andrus, R.E. and Y.I. Kosovich-Anderson. 2011. Two *Sphagnum* Sect. Cuspidata, new to the western conterminous United States. Evansia 28(2): 54-57.

Eckel, P.M. 2007. County checklist of the mosses of Wyoming. Res Botanica, a Missouri Botanical Garden Web Site. http://www.mobot.org/plantscience/resbot/1Bryo.htm . August 17, 2007.

Kosovich-Anderson, Y.I. 2011. Two Dicranaceae species from the Beartooth Plateau, new to Wyoming. Evansia 28(2): 50-53.

Kosovich-Anderson, Y.I. and M.S. Ignatov. 2010. Three interesting Brachytheciaceae mosses from the Beartooth Plateau (Rocky Mountains, Wyoming, U.S.A.). Arctoa 19: 183-190.

Kosovich-Anderson, Y.I. and J.R. Spence. 2008. A remarkable new range extension of the subtropical *Brachymenium vinulosum* Cardot (Bryaceae). Evansia 25 (4): 90-93.

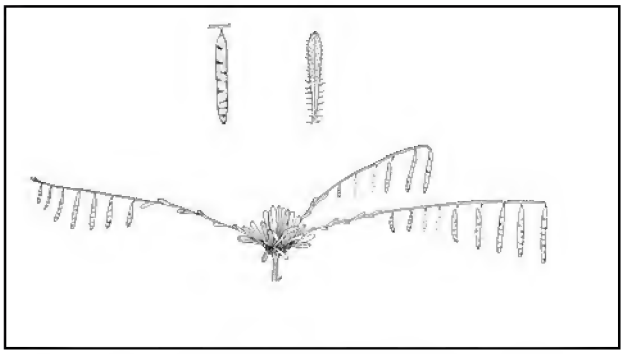
Weber, W.A. and R.C. Wittmann. 2007. *Bryophytes of Colorado - Mosses, Liverworts, and Hornworts*. Pilgrims Process, Inc.

Two Wyoming Plants Become Candidates for Federal Listing

This past summer, the U.S. Fish and Wildlife Service (USFWS) issued determinations that listing whitebark pine and small rockcress (also called Fremont County rockcress) as threatened or endangered are warranted but precluded by higher priorities under the Endangered Species Act. Thus, they become candidates for federal listing.

Ancient whitebark pine in the timberline zone.
From: Arno, S.F. and R.J. Hoff. 1989. Silvics of whitebark pine (*Pinus albicaulis*). General Technical Report INT-253. USDA Forest Service Intermountain Research Station, Ogden, UT.

Whitebark pine (*Pinus albicaulis*) was petitioned in 2008 with evidence of widespread decline throughout its range. Its range extends from the northern Cascades and northern Rocky Mountains of British Columbia and Alberta, south to California, with isolated stands in Nevada, and presence in the Greater Yellowstone area that includes large areas of northwestern Wyoming; about 44% of its range lies in the United States. *P. albicaulis* was petitioned previously in 1991, but that petition did not present substantial information indicating that listing may be warranted. In the 2011 finding, the Service determined that the species is threatened by the loss of habitat from fire suppression, the exacerbating environmental effects of climate change, and mortality from white pine blister rust and mountain pine beetle. The USFWS deemed existing regulatory mechanisms in place for *P. albicaulis* to be inadequate to reduce or eliminate these threats. The decision and supporting information is presented in the Federal Register 76(138): 42631-42654 issued 19 July. Upon publication of this petition-finding, the USFWS added *P. albicaulis* to the candidate species list and will continue to accept additional information and comments concerning this finding.

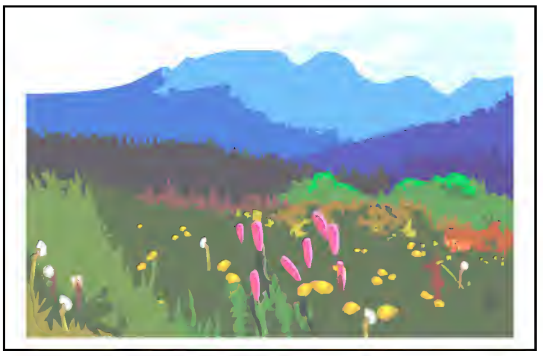


Small rockcress (*Boechera pusilla*). By Isobel Nichols.
From: Fertig, W., C. Refsdal, and J. Whipple. 1994. *Wyoming Rare Plant Field Guide*. Wyoming Rare Plant Technical Committee, Cheyenne, WY.

Small rockcress (*Boechera pusilla*; syn. *Arabis pusilla*) was among 206 species petitioned in 2007 across the mountains and plains states of USFWS Region 6 that had NatureServe global ranks indicating they are globally imperiled. *Boechera pusilla* is restricted to one site near South Pass in the Wind River Range of Fremont County, Wyoming. In 1983, it was added as a category 2 taxa (48 FR 53640), and proposed to remain as a candidate when the category 2 list was discontinued in 1996 (61 FR 7596). It was officially retained as a candidate in 1997 (62 FR 49398). Initiatives of the Bureau of Land Management (BLM), taking place mainly in 1998 included construction of an exclosure to eliminate vehicle access and grazing, development of a habitat management plan for the species, designation of the area as an Area of Critical

Environmental Concern, and incorporation of the area into a Special Management Area with 50-year withdrawal from most mining activities. In response, the USFWS placed it among species considered for removal from the candidate list in 1999 (64 FR 57534), a change of status that was finalized in 2000 (64 FR 57534). In this year's decision, the USFWS cited 2003 and 2010 monitoring data showing population numbers were well below the lower end of the 500-5000 figures that have been cited as representing minimum viable populations. The USFWS determined that threats may persist as indicated by the species' small, declining population size, whether associated with drought or other conditions. The decision and supporting information is presented in the Federal Register 76(111): 33924-33965 issued 9 June. Upon publication of this petition-finding, the USFWS added *B. pusilla* to the candidate species list and will continue to accept additional information and comments concerning this finding.

The small rockcress petition-finding also determined that four plant species did not warrant protection under the Endangered Species Act: Yellowstone sand verbena (*Abronia ammophila*), Ross' bentgrass (*Agrostis rossiae*), precocious milkvetch (*Astragalus proimanthus*) and Gibbens' penstemon (*Penstemon gibbensii*). Four other Wyoming plant species among the 206 were previously addressed in 2009 as not warranting protection (74 FR 6122; *Castilleja* 28(1)). bh



Botanist's Bookshelf – (plant publications for everyone):
Harrison, Orval C. 2010. ***Wildflowers of Star Valley and the Tri-Basin Country***.
(ISBN: 978-0-615-34902-2). 432 pages $24.75 (Order from: Orval C. Harrison 1781 Hollywood Ave., Salt Lake City, UT 84108; orvalharrison@hotmail.com)

Review by Chris Madson

(*Editor's note: The following book review is reprinted from Wyoming Wildlife, February 2011, with permission.*)

Those of you who have done battle with one of the classic dichotomous keys to plants must certainly have felt the magnetic allure of the field guide with lots of color plates. The photos often save tedious dissection of flowers, repeated visits to the glossary – what was the difference between "ciliolate" and "lanulose" again? – and repeated fumbling with a ruler graduated in millimeters. The trouble with a photo guide is that there never seems to be enough room to contain all the flowers one is likely to meet.

Orval Harrison found a way to remedy this shortcoming – he narrowed his focus to the Star Valley and environs. The book that results includes 570 plant species, the majority of which are pictured in full color. As he wrote, Harrison worked extensively with the Rocky Mountain Herbarium at the University of Wyoming, perhaps the best institution of its kind in the interior West, so the taxonomy reflected in the book is about as accurate as science can make it. Harrison's photos are expertly done and reproduced.

If your wanderings take you to the Star Valley, this book will probably answer any question of plant identification that arises. As you move farther away, the book's encyclopedic completeness will eventually fail, but as long as you're in western Wyoming, eastern Idaho, or northeastern Utah, you'll find that it covers most of the flowers you're likely to see.

As the years go by, I find myself carrying more and more of these focused field guides. These days, I have a briefcase full of them wedged behind the pickup seat. This one's going in the briefcase.

Spruce species and their hybrids, continued from p.1

Daubenmire (1974) suggested, based on observed intermediate morhological traits, that white and Engelmann spruce hybrids exist as far south as the central Rocky Mountains in the United States. Opportunities for hybridization occur along elevational gradients where these species co-occur, from northwestern Wyoming north through the central Rocky Mountains and British Columbia. Moreover, hybrids of these long-lived trees might occur in areas where one or both of the parental species is no longer present (Ledig *et al.* 2004). Based on these and other researchers' observations, we initiated a study in 2009 to investigate the genetic distribution of parental white and Engelmann spruce species and their putative hybrids in various mountain ranges in Wyoming. We identified individual trees by their genetic composition and determined their geographic distribution across sampled forest populations (Figure 1).

One of the challenges for species and hybrid identification in spruce stems from overlap between the morphological traits of the species (Figure 2; next page). Our genetic results can be helpful for future forest inventories and management decisions by calling attention to the existence of hybrids within our region and to a more southern distribution of white spruce than previously recognized. For example, the GYE contains not only the two parental spruce species but is also home to variable hybrid progeny. By identifying and characterizing the distribution of these hybridizing taxa, this study lays the groundwork for additional research of the ecological affinities of these species and their hybrids. We have initiated more comprehensive analysis of differentiation and hybridization in all western North American spruce and will build useful statistical models of their ecological associations and geographic distributions.

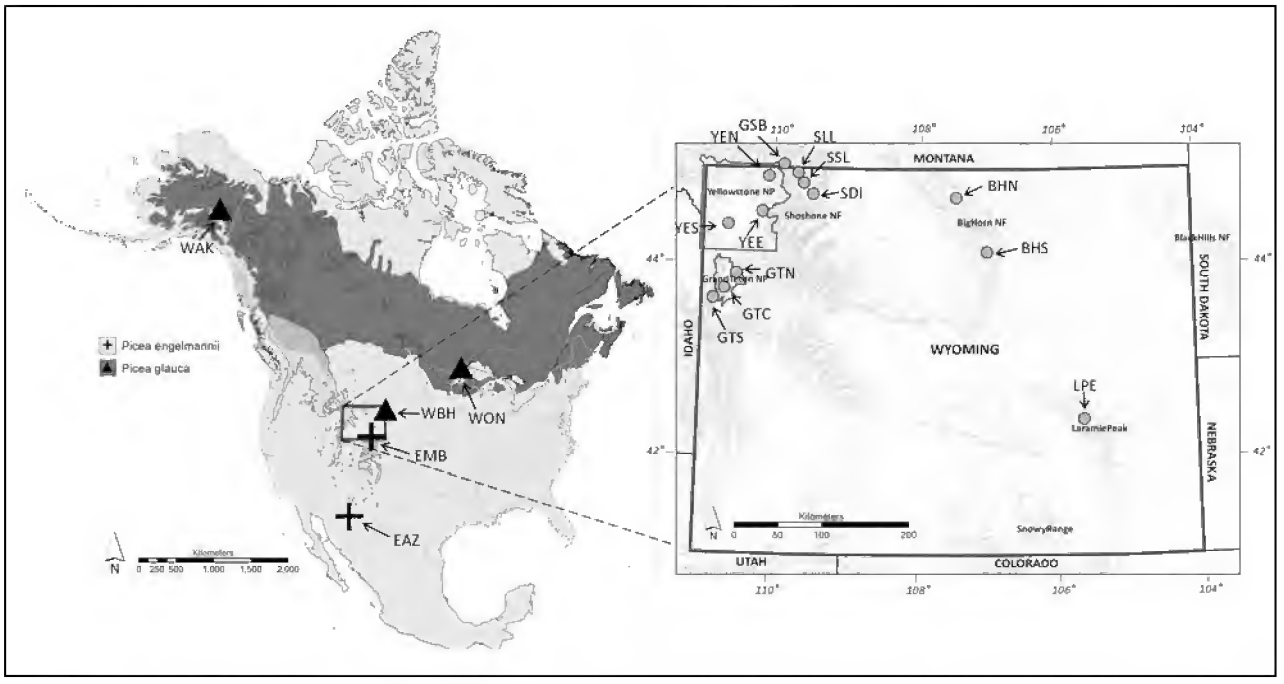


Figure 1*:* Left: Geographic ranges and collection sites of *Picea engelmannii* and *Picea glauca* parental species in North America (USGS). Right: Specific collection sites in Wyoming that were studied for presence of hybrids and parental species. Sampled parental populations: Pinaleño Mtns, AZ (EAZ); Snowy Range, Medicine Bow NF, WY (EMB); Black Hills NF, SD (WBH); Fairbanks, AK (WAK); Thunder Bay, ON Canada (WON). Sampled populations of unknown ancestry: Laramie range, WY (LPE); Grand Teton NP-South, WY (GTS); Grand Teton NP-Central, WY (GTC); Grand Teton NP-North, WY (GTN); Yellowstone NP-South, WY (YES); Yellowstone NP-East, WY (YEE); Yellowstone NP-North East, WY (YEN); Soda Butte, Gallatin NF, MT (GSB); Lily Lake, Shoshone NF, WY (SLL); Swamp Lake, Shoshone NF, WY (SSL); Dead Indian, Shoshone NF, WY (SDI); Big Horn Mtns-South, WY (BHS); Big Horn Mtns-North, WY (BHN).

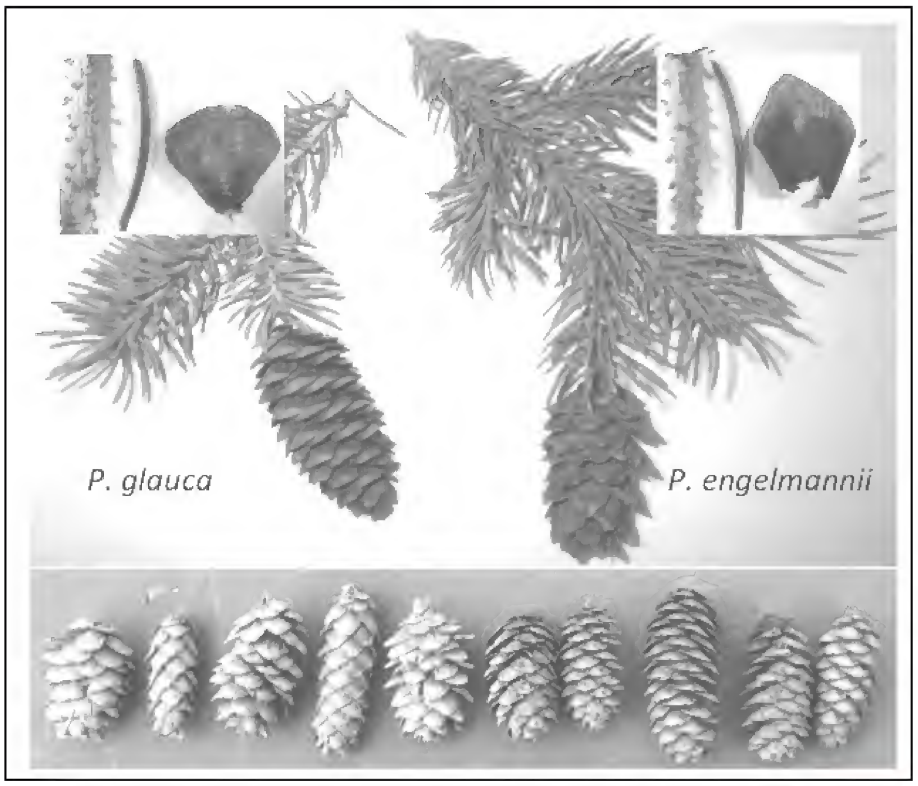


Figure 2: Top: photo of twigs, needles and cones of the parental white spruce (left) and Engelmann spruce (right).

Bottom: photo of highly variable cones from Shell Creek Canyon in the Big Horn Mountains.

Literature Cited

Daubenmire R (1974) Taxonomic and ecologic relationships between *Picea glauca* and *Picea engelmannii*. *Canadian Journal of Botany*, 52, 1545–1560.

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The Wyoming Native Plant Society homepage will be moving! Look for more information in the next newsletter.

The Big Cedar Ridge hike offered views of luxuriant fossil plants, lead by Scott Wing, Smithsonian (upper left). *We welcome digital photographs of all Wyoming Native Plant Society events.*

U-WY Library and Heritage Center News

Aven Nelson's collection books (1894-1937) and those of his students are now posted by U-WY Libraries at: http://uwlib5.uwyo.edu/blogs/digital_collections/digital-collections-the-uw-libraries/collection-books/

In addition, papers and correspondence of many Wyoming botanists, past and present, are being posted by the U-WY American Heritage Center archives, at: http://rmoa.unm.edu/

Robert and Jane Dorn
Robert and Jane Dorn are Wyoming botanists and ornithologists who work extensively in the Rocky Mountain West.

Aven Nelson
Nelson founded the Rocky Mountain Herbarium. See the separate Library URL for his collection books.

W.G. Solheim
Solheim was a leading mycology researcher in Wyoming. He also led the University team in Afghanistan, 1963-1965, under contract for the Agency for International Development.

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